

What is claimed is:

1. A method of operating on a workpiece (6) comprising the steps of:
  - 5 a. deforming a C-shaped counterforce structure (9) with a sufficiently large force, while the counterforce structure (9) carries the workpiece (6);
    - 10 b. measuring the deformation of the C-shaped counterforce structure (9); and
    - c. correcting the force of the operation to a predetermined amount to produce a uniform result responsive to the extent of the deformation.
  - 15 2. A method of operating on a workpiece (6) carried on a female die (5) mounted on one end of a C-shaped counterforce structure (9) and on which is mounted, at the other end thereof, a device (8) having a pick-up device (4), and a male die (3) guided by the pick-up device (4), the method comprises the steps of:
    - 20 a. measuring the relative movement between the counterforce structure (9) and the pick-up device (4) with a first sensor (1);
    - b. measuring the relative movement between the pick-up device (4) and the male die (3) with a second sensor (2); and
    - 25 c. setting a uniform depth of operation on the workpiece (6) responsive to the measurements of the first sensor (1) and the second sensor (2).
  3. The method claimed in Claim 2 with the additional step of:
    - 30 a. calibrating the setting of the male die (3) responsive to the measurements of the first sensor (1) and the second sensor (2), each of which has recorded a reference value.

4. The method claimed in Claim 3 with the additional steps of:

a. measuring the movement between the counterforce structure (9) and the pick-up device (4) by the first sensor (1) during the operation on the workpiece (6); and

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b. controlling the movement of the male die (3) responsive to the measured movement to set a rivet head projection in the workpiece (6).

5. The method claimed in Claim 4 with the additional step of:

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a. recording the measured deformation of the counterforce structure as a quality signal of any one of a selective quality of the counterforce structure (9), the nature of the workpiece (6), the rivets and the male and the female dies (3 and 5), or the process of the operation.

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6. A method of riveting a workpiece (6) comprising the steps of:

a. deforming a C-shaped counterforce structure (9) with a sufficiently large force, while the counterforce structure (9) carries the workpiece (6);

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b. measuring the deformation of the C-shaped counterforce structure (9); and

c. correcting the force of the riveting to a predetermined amount to produce a uniform result responsive to the extent of the deformation.

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7. A method of riveting a workpiece (6) carried on one end of a C-shaped counterforce structure (9) above a female die (5) mounted in the counterforce structure (9), and on the other end of which a device (8) is connected, the device (8) has a pick-up device (40 and a male die (3) guided by the pick-up device (4) and to coact with the female die (5), the method comprising the steps of:

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a. applying a force on the workpiece (6);

- b. measuring the relative movement between the counterforce structure (9) and the pick-up device (4) with a first sensor (1);
- 5           c. measuring a single relative movement, selectively, between the pick-up device (4) and the male die (3), and the male die (3) and the counterforce structure (9) with a second sensor (2); and
- 10          d. adjusting the depth of the riveting to a predetermined value responsive to the measured values of the first sensor (1) and the second sensor (2).
8. The method claimed in Claim 7 with the additional step of:
- 15          a. calibrating the setting of the male die (3) responsive to the measurements of the first sensor (1) and the second sensor (2), each of which has recorded a reference value.
9. The method claimed in Claim 8 with the additional step of:
- 20          a. calibrating the setting of the male die (3) responsive to the measurements of the first sensor (1) and the second sensor (2), each of which has recorded a reference value.
10. A method of riveting a workpiece (6) with a rivet having a rivet head that projects upwardly from the workpiece (6) that is carried on one end of a C-shaped counterforce structure (9) above a female die (5) mounted in the counterforce structure (9) and on the other 25 end of which a device (8) is connected, the device (8) has a pick-up device (4) and a male die (3) guided by the pick-up device (4) and to coact with the female die (5), the method comprising the steps of:
- 30          a. applying a force on the workpiece (6);
- b. measuring the relative movement between the counterforce structure (9) and the pick-up device (4) with a first sensor (1);

c. measuring a single relative movement, selectively, between the pick-up device (4) and the male die (3), and the male die (3) and the counterforce structure (9) with a second sensor (2); and

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d. adjusting the height of the projection of the rivet head to a predetermined value responsive to the measured values of the first sensor (1) and the second sensor (2).

11. The method claimed in Claim 10 with the additional step of:

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a. calibrating the setting of the male die (3) responsive to the measurement of the first sensor (1) and the second sensor (2), each of which has recorded a reference value.

12. The method claimed in Claim 11 with the additional steps of:

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a. measuring the movement between the counterforce structure (9) and the pick-up device (4) by the first sensor (1) during the riveting of the workpiece (6); and

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b. controlling the movement of the male die (3) responsive to the measured movement to set a rivet head projection in the workpiece (6).

13. The method claimed in Claim 12 with the additional step of:

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a. recording the measured deformation of the counterforce structure (9) as a quality signal of any one of a selective quality of the counterforce structure (9), the nature of the workpiece, the rivets and the male and the female dies (3 and 5) or the process of the operation.

14. A method of piercing a workpiece (6) carried on a C-shaped counterforce structure (9) comprising the steps of:

a. deforming a C-shaped counterforce structure (9) with a sufficiently large force,

5 while the counterforce structure (9) carries the workpiece (6);

b. measuring the deformation of the C-shaped counterforce structure; and

c. correcting the force of the piercing to a predetermined amount to produce a

10 uniform result responsive to the extent of the deformation.

15. The method claimed in Claim 14 with the additional steps of:

a. measuring the movement between the counterforce structure (9) and the pick-

15 up device (4) by the first sensor (1) during the piercing of the workpiece (6); and

b. controlling the movement of the male die (3) responsive to the measured

movement to set a rivet head projection in the workpiece (6).

20. The method claimed in Claim 15 with the additional step of:

a. recording the measured deformation of the counterforce structure (9) as a quality signal of any one of a selective quality of the counterforce structure (9), the nature of the workpiece (6), the rivets and the male and female dies (3 and 5), or the process of the

25 piercing.

17. An operating device (8) mounted on one end of a C-shaped counterforce structure (9) on which the other end has mounted thereon a female die (5) which carries a workpiece (6) comprising:

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a. a pick-up device (4) moveable in the direction of the female die (5);

- b. a male die (3) guided by the pick-up device (4) to be moveable in the direction of the female die (5);
- c. a first sensor (1) to measure the relative movement between the pick-up device (4) and the counterforce structure (9); and
- d. a second sensor (2) selectively to measure the relative movement between the pick-up device (4) and the male die (3) and between the male die (3) and the counterforce structure (9).

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18. The combination claimed in Claim 17 wherein:

- a. the first sensor (1) defines a digital counter.

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19. The combination claimed in Claim 18 wherein:

- a. a monitoring unit (7) measures the value of the first sensor (1) and the second sensor (2) to calculate and record the deformation of the counterforce structure (9) from the measured values of the first sensor (1) and the second sensor (2).

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20. A riveting device (8) mounted on one end of a C-shaped counterforce structure (9) on which the other end has mounted thereon a female die (5) which carries a workpiece (6) comprising:

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- a. a pick-up device (4) moveable in the direction of the female die (5);
- b. a male die (3) guided by the pick-up device (4) to be moveable in the direction of the female die (5);
- c. a first sensor (1) to measure the relative movement between the pick-up device (4) and the counterforce structure (9); and

d. a second sensor (2) selectively to measure the relative movement between the pick-up device (4) and the male die (3) and between the male die (3) and the counterforce structure (9).

5 21. The combination claimed in Claim 20 wherein:

a. the first sensor (1) defines a digital counter.

22. The combination claimed in Claim 21 wherein:

10 a. a monitoring unit (7) measures the value of the first sensor (1) and the second sensor (2) to calculate and record the deformation of the counterforce structure (9) from the measured values of the first sensor (1) and the second sensor (2).

15 23. A piercing device (8) mounted on one end of a C-shaped counterforce structure (9) on which the other end has mounted thereon a female die (5) which carries a workpiece (6) comprising:

a. a pick-up device (40 moveable in the direction of the female die (5);

20 b. a male die (3) guided by the pick-up device (4) to be moveable in the direction of the female die (5);

c. a first sensor (1) to measure the relative movement between the pick-up device

25 (4) and the counterforce structure (9); and

d. a second sensor (2) selectively to measure the relative movement between the pick-up device (4) and the male die (3) and between the male die (3) and the counterforce structure (9).

24. The combination claimed in Claim 23 wherein:

- a. the first sensor (1) defines a digital counter.

5 25. The combination claimed in Claim 24 wherein:

- a. a monitoring unit (7) measures the value of the first sensor (1) and the second sensor (2) to calculate and record the deformation of the counterforce structure (9) from the measured values of the first sensor (1) and the second sensor (2).

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26. A self-piercing device (8) mounted on one end of a C-shaped counterforce structure (9) on which the other end has mounted thereon a female die (5) which carries a workpiece (6) comprising:

- a. a pick-up device (4) moveable in the direction of the female die (5);

15 b. a male die (3) guided by the pick-up device (4) to be moveable in the direction of the female die (5);

20 c. a first sensor (1) to measure the relative movement between the pick-up device (4) and the counterforce structure (9); and

25 d. a second sensor (2) selectively to measure the relative movement between the pick-up device (4) and the male die (3) and between the male die (3) and the counterforce structure (9).

27. The combination claimed in Claim 26 wherein:

- a. the first sensor (1) defines a digital counter.

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28. The combination claimed in Claim 27 wherein:

- a. a monitoring unit (7) measures the value of the first sensor (1) and the second sensor (2) to calculate and record the deformation of the counterforce structure (9) from the measured values of the first sensor (1) and the second sensor (2).

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